Leverage Bubbles

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Abstract

This paper investigates the relation between liquidity and asset prices. It shows that, when banks balance sheets are marked to market and banks are targeting a financial leverage level - a situation similar to current environment - formation of Leverage Bubbles of important size is highly likely. This paper studies the Leverage Bubble phenomenon and suggests a new regulation rule based on a Dynamic Leverage Ratio (DLR) rule.

Keywords: Financial Crises, Rational bubbles, Dynamic Leverage Ratio, Mark to Market accounting, Asset pricing, Macroprudential Regulation, Market Liquidity

JEL Classification: G01, G14, G18, G20, G28

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1 Introduction

There is hardly a unique market consensus about future firms dividends or future defaults or liquidity risk. Different investors use different prediction and information extraction techniques[1] leading ineluctably to a variety of opinions. The observed price on the market is an equilibrium price of all supplies and demands and hardly reflect a consensus price. Moreover all participants are not equally informed. Information gathering cost and technology advance is not equally distributed among all participants. Advanced players like banks are more prone to access and process information when less specialized players would read information from these investors action and would be sensible to their opinions and recommendations. Bubbles and overreaction are the product of such market imperfections. In common knowledge, Bubbles are typically defined as a dramatic asset price increases followed by a collapse. In a more formal definition, bubbles arise if the asset price exceeds its "fundamental value". Before the recent worldwide commodities and housing bubble (2003-2007) there have been famous historical bubbles that already attract important attention from economist and public[2]. Fascination for bubbles lead to various modeling suggestions in the literature: there are models where agents are rational and information is symmetric[3], models where agents are rational and information asymmetric [4], and models where agents are irrational[5].

Although this literature did not stressed enough the role of the trading constraints. Indeed, traders not only react to fundamental information, they can also respond to other needs like regulation requirement, risk management constraints, or predefined trading strategies. For instance, Adrian and Shin (2008) provide empirical evidence that banks and financial intermediaries manage very closely their leverage. In this paper we also argue that banks and financial intermediaries leverage strategy lead to the formation of endogenous rational bubble. This paper extends then the literature on asset bubbles. It also represents a contribution to recent works about financial instability factors. Here, banks assets and liabilities accumulation are the product of continuous re-leveraging of balance sheet and induce the overshoot of asset prices. This could explain the empirical relevance of banks assets or credits growth as a bubble or pre-crisis

[1] Fundamental analysis, historical prices patterns, prices momentum, macro indicators, forecasting of agents behavior, ...

[2] The Dutch Tulip Mania (1634-1637), the Mississippi Bubble (1719-1720) and the South Sea Bubble (1720). More recently, one can cite the internet bubble (1996-2000).

[3] Although in a complete market where information is symmetric the formation of persistent miss-pricing is very unlikely. Tiroles (1992) showed that, assuming rational expectations and a finite number of participants, in a market equilibrium with complete information a bubble cannot exist.

[4] Allen and Gorton (1993), Allen, Morris and Postlewaite (1993)

[5] Shiller (2005) describes a model of "irrational exuberance" bubbles. When asset prices start to rise, the success of some investors attracts public attention. New investors extrapolate recent price action far into the future and enter the market. By buying more assets they put an upward pressure on prices.

indicator[6]. Finally this work is part of recent efforts to understand the efficiency of current regulation in avoiding financial instability and to suggest new regulation ideas. This paper is organized as follow: The first part is an attempt to throw light on the procyclical effects of financial institutions active leveraging in presence of illiquidity and Mark to Market accounting rules. In a second part asset prices overshoot is derived. In a third part it draws a framework were, in a rational equity bubble setting, the bubble component comes from this price overshoot. Finally, within the conclusion and policy recommendations section, I suggest a new regulation rule based on a Dynamic Leverage Ratio (DLR) that would protect the financial system from leverage bubbles.

2 Active leveraging

We can distinguish two categories of investors: investors that do not actively manage their leverage like household and other non financial firms, and investors that actively leverage their position (use the extra capital to build extra leveraged positions) like banks and financial intermediaries[7]. I first provide a simple illustration of what is leverage. For this purpose I use a stylized bank balance sheet that is divided in two parts: Assets part and Liabilities and Equity part.

Asstes	Liability
Securities (S)	Equity (E) Debt (D)

Fig. 1: Simplified balance sheet

Leveraging can be defined as the use of debt to increase the return to equity. I use a measure of leverage that is L: the Debt over Assets ratio:

$$L = \frac{D}{S}$$

Since the value of the assets must balance the value of the liabilities, the leverage level L varies between zero and one. Zero means a non leverage situation where all securities are financed by equity. One means full or infinite leverage situation where all securities are financed by repo. In practice the full leverage is never reached because of collateralizing and margin calls.

In current financial system regulation the balance sheets are continuously marked to market. Banks and financial intermediaries balance sheets reflect

[6] For example Borio and Lowe (2002) were able to predict about 80% of crises since the 1970s using the excess of credit growth.

[7] Adrian and Shin (2008) paper showed that financial intermediaries and investment banks have been actively building leverage in recent booming period in opposition to household and non financial firms.

immediately any changes in asset prices. As a consequence, asset prices fluctuations have an instant impact on the net worth of the financial system participant. The fluctuation of the asset prices not only affect the net worth of the financial institution it also affects their leverage. It is important to see that leverage is negatively correlated with assets prices excess return over the risk free rate[8]. We provide a simple illustrative example where the banks assets return is 12% and the risk free interest rate is assumed to be 5%:

Assets	Liability		Assets	Liability
$S_t = 100$	$E_t = 20$ $D_t = 80$	$\Rightarrow$	$S_{t+1} = 112$	$E_{t+1} = 28$ $D_{t+1} = 84$
L=80%			L=75%	

Fig. 2: Leverage fluctuation example

The leverage decreases from 80% to 75%. It is then inversely related to total assets growth over the debt growth rate. The same principle applies for the effect of housing prices on a mortgage Loan To Value (LTV). When the price of a consumer's house goes up his net worth increases, and thus his mortgage LTV goes down.

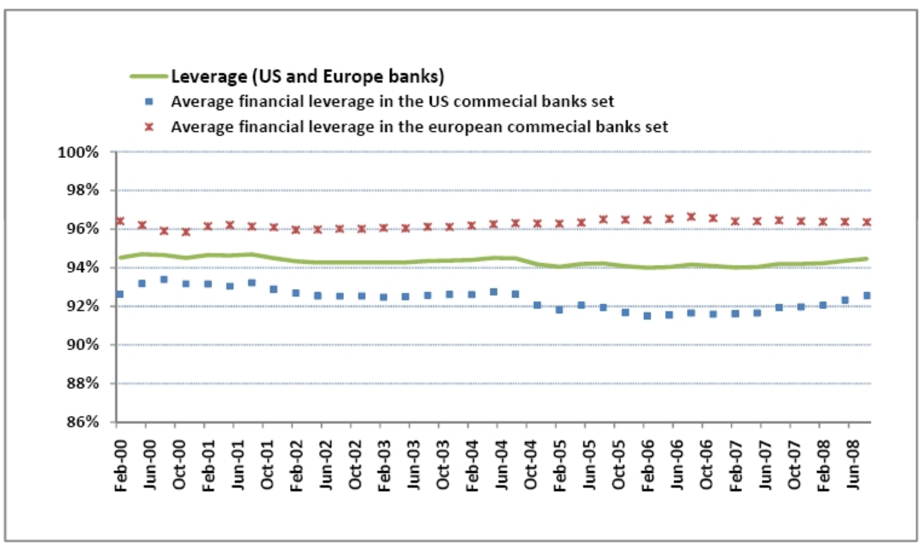

Fig. 3: Commercial banks leverage targeting

Figure 3 shows the average leverage of a set[9] of main US and European (Den-

[8] Here I assume that the financial institution borrows at the risk free rate although in general interest rate payed on depts should be used

[9] The full banks set is:

mark, France, Germany, Italy, Spain, Sweden, UK) commercial banks between 2000 and 2009. The average leverage appears to be fairly constant thought the business cycles of 2000-2003 and 2003-2009. This suggests that banks use to manage very closely their leverage and manage their asset to target a constant leverage. This evidence is similar to Adrian and Shin (2008) finding on US commercial banks leverage behavior[10].

3 Price overshoot

In this framework I assume a simple strategy of active leveraging: banks are targeting a constant level of leverage $D_t/S_t = L$. Figure 3 gives evidence of such practice in Europe and US. In addition, commercial banks in some countries like Canada[11] and more recently Switzerland have a leverage ratio limit defined by the regulators. Since this level is lower then the level practiced in other countries Banks naturally choose to target the regulatory leverage.

In the presence of continuous use of Mark to Market (MtM) valuation, targeting a constant level of leverage cannot be achieved without active re-leveraging. As noted earlier the balance sheets of financial institutions reflects immediately any change in asset prices.

Assets	Liability
S_t	E_t D_t
$L_t = \frac{D_t}{S_t}$	

$\Rightarrow$

Assets	Liability
$S_t(1+R_{t+1})$	E_{t+1} $D_t(1+R)$
$L_{t+1} = \frac{D_t(1+R)}{S_t(1+R_{t+1})}$	

Fig. 4: Asset fluctuation effect on the balance sheet

The leverage continuously moves with the asset price evolution. And the leverage growth can be related to asset prices growth by the following relation:

$$L_{t+1} = \frac{D_t(1+R)}{S_t(1+R_{t+1})} = \left(\frac{1+R}{1+R_{t+1}}\right) L$$

$$\frac{\Delta L_{t+1}}{L_t} = -(R_{t+1} - R) \tag{3.1}$$

Barclays, Hsbc Holdings, Lloyds, Northern Rock, Royal Bank Of Scotland, Danske Bank, Bnp Paribas, Credit Mutuel Group, Societe Generale, Bayerische Hypo-Und Vereinsb, Bayerische Landesbank, Commerzbank, Dresdner Bank, Banca Carige, Banca Monte Dei Paschi Siena, Intesa Sanpaolo, Unicredit, Banco Bilbao Vizcaya Argenta, Banco Popular Espanol, Banco Santander, Nordea Bank, Svenska Handelsbanken-A, Bank Of America, Citigroup, Jpmorgan Chase & Co, Wachovia Corp, Wells Fargo & Co.
The Leverage shown is the average Leverage of available quarterly data in Bloomberg.

[10] Adrian and Shin (2008) uses aggregate US commercial banks data from 1963 to 2006 to show that leverage growth have been fairly insensitive to asset growth.

[11] In Canada the leverage ratio is limited to 95% (Assets are limited to 20 times the capital size).

Leverage growth is negatively related to total assets excess return. How would the financial institution react to variation in leverage when targeting a level of L? It would naturally need to re-leverage its position by buying or selling more assets and by increasing or decreasing their borrowing.

$$\begin{tikzcd}
P_t \arrow[r] & P^*_{t+1} \arrow[r, dotted] \arrow[d] & P_{t+1} \\
& Leveraging\,[Q_0 \rightarrow Q_1 \rightarrow ...] \arrow[ur] &
\end{tikzcd}$$

Lets call P^*_{t+1} the price resulting from an initial price shock and $Q_0 = Q_t$ the quantity of assets banks and financial intermediaries holds before the re-leverage or de-leverage. I denote the fundamental price return:

$$R^F_{t+1} = \frac{P^*_{t+1} - P_t}{P_t}$$

R^F_{t+1} represents the price percentage change that would prevail in the absence of leverage targeting. ΔQ_1 denotes the quantity of asset purchased by the investor to regain the leverage level of L. It is then the solution of:

$$\frac{D_t(1+R) + \Delta Q_1 P^*_{t+1}}{S_t(1+R^F_{t+1}) + \Delta Q_1 P^*_{t+1}} = L$$

Resolving this equation leads to:

$$\Delta Q_1 = \frac{S_t}{P^*_{t+1}} \frac{L}{1-L}(R^F_{t+1} - R) \tag{3.2}$$

An important recent finance literature diverges from the classical assumption of market efficiency (Grossman and Stiglitz (1980), Kyle (1985), Glosten and Milgrom (1985), Grossman and Miller (1988))[12] and shows that asymmetric information introduces a slope in the demand and supply curve. I call γ the elasticity of the price with respect to the quantity Q of assets held by banks and financial intermediaries:

$$\gamma = \frac{\Delta P/P}{\Delta Q/Q}$$

In an efficient market γ is null. When there are market imperfections γ is strictly positive. It is out of the scope of this paper to model market imperfections, whereas a straightforward theory explaining the potential positiveness of γ is the following: Uniformed investors read information from the quantity traded by informed investors. The reason why there are uninformed players is simple: information is not a free good. It is costly to collect and to analyze.

[12] There has also been empirical works pointing out the non null slope of demand curves for assets (Some early examples are Shleifer (1986) and Loderer, Cooney and van Drunen (1991))

We can think about banks and financial intermediaries as investors detaining private clients information. We can also see them as financial market industries where the information marginal cost is much lower then an average size investor. This makes banks and financial intermediaries *price setters*: an asset purchase from these investors puts upward pressure on its price. Equivalently, an asset sell puts downward pressure on the price.[13]

Investors response to a price shock is assumed instantaneous. Using the price elasticity definition equation 3.2 translates to:

$$\Delta P_1 = \frac{\gamma_{t+1} L}{1-L} P_t (R^F_{t+1} - R) \tag{3.3}$$

Where ΔP_1 is the price reaction to asset quantity change. Since asset prices moved by ΔP_1 the leverage is again affected. The price movement translates to further price purchases or sales by banks and financial intermediaries in order to keep the leverage constant. Again the purchases or sales translates into price reaction:

$$\begin{tikzcd}
\Delta P_0 = P^*_{t+1} - P_t \arrow[dr] & & \Delta P_1 \arrow[dr] & & \cdots \arrow[dr] & & \Delta P_\infty \\
& \Delta Q_1 \arrow[ur] & & \Delta Q_2 \arrow[ur] & & \cdots \arrow[ur] &
\end{tikzcd}$$

The equation driving the successive changes in prices is also derived from the active leverage targeting strategy.

$$\Delta P_{i+1} = \frac{\gamma_{t+1} L}{(1-L)} \Delta P_i, \text{ with } i = 1, .., +\infty \tag{3.4}$$

A simple way to derive it is to first notice that

$$\frac{\Delta D_{i+1}}{\Delta E_i} = \frac{L}{1-L}$$

where ΔD_{i+1} is the variation in debt needed to cover additional assets purchase/sale when the equity value moves by ΔE_i. The net wealth of the financial institution between i and $i+1$ moves because of asset price overshoot ΔP_i and the MtM net gain/loss is $\Delta E_i = Q_i \Delta P_i$. It follows that

$$P_i \Delta Q_{i+1} = \frac{L}{(1-L)} Q_i \Delta P_i$$

which lead to equation 3.4. Convergence to zero of the series ΔP_i requires to have:

[13] Note that γ is not the price elasticity of demand or supply and Q_t is not the quantity of total asset demanded or supplied on the market at time t. Q_t is instead the volume of assets hold by banks and financial intermediaries since they are the usual informed players. γ is indeed the elasticity of the price with respect to the quantity of asset held by banks and financial intermediaries.

$$\frac{\gamma_{t+1}L}{(1-L)} < 1$$

This condition is necessary to have a finite equilibrium prices $P_{t+1} = P_\infty$. In an efficient market, γ is null, and there is no further price adjustment. In imperfect market, γ is strictly positive but assumed small enough to ensure the convergence of ΔP_i. Figure 3 shows that worlds top banking institutions held on average about 6 percent of capital. A simple rule of targeting a leverage of 94% would mean that the price converges only when γ is lower than 6%.

Frictions on the market measured by γ are also called market illiquidity. In a highly illiquid market where banks transaction has an important impact on assets prices the convergence condition can be violated. A way to fix that is to set γ as function of the overshoot reaction level saying that the higher the deviation from the fundamental price the more visible the missprice[14]. A state dependant γ is also one way of ensuring the non negativity of prices[15].

To summarize, when the asset prices return differs from the liability interest rate, there is a series of position adjustment made by financial institution practicing an active leverage targeting. This adjustment is procyclical as active leveraging overshoots up or down the price excess return. The series of position adjustment made by financial institution is assumed instantaneous. Denoting R_{t+1} the price return at time $t+1$ after the overshoot occurs, I find that the excess return caused by the leveraging effect is proportional to the initial "fundamental" excess return over the risk free rate:

$$R_{t+1} - R^F_{t+1} = \frac{\gamma_{t+1}L}{(1-L)-\gamma_{t+1}L}\left(R^F_{t+1} - R\right) \tag{3.5}$$

The series of position adjustment may not be assumed instantaneous. This is beyond the scope of our model whereas it is important to point out some interesting facts. When the overshoot is not instantaneous, the price convergence may not be fully realised before another fundamental shock lead to a new series of adjustment. This would partly explain the so called asset price momentum puzzle. An initial positive shock makes the prices continue to rise until convergence or a new "fundamental" chock happens. It is also interesting to see that the momentum level is a function of the market illiquidity or friction factor γ and the level of leverage L. The higher the leverage and the the higher the illiquidity the higher the convergence time of the series ΔP_i. As seen earlier the convergence to a new price is not guaranteed for high levels of market illiquidity. When adjustment are not instantaneous, the new asset price is not necessarily

[14] In practice one can think about crisis situations where the panic and uncertainty are important enough to lead to a high sensitivity to negative asset quantity variations. In such situations price movement overshoot can be significatively high to be qualified as market crash.

[15] The positive likelihood of negative prices, although small, is a shortcoming that the simple setting with constant γ would share with other rational bubble models.

undefined. But asset prices momentum is infinite and it only disappears with an opposite new fundamental shock.

4 Rational Leverage bubble framework

Stock prices are usually expressed as the expected value of future dividends D. Using a constant discount rate R the stock price P_t is:

$$P_t = \sum_{j=1}^{+\infty} \left(\frac{1}{1+R} \right)^j E_t D_{t+j}$$

Since LeRoy and Porter (1981) and Shiller (1981) papers showing the excess volatility of the stock prices compared to the dividends, new subsequent works have been done to depart from this representation. The rational bubbles literature is based on rational expectation and the same dividend/price fundamental relation:

$$P_t = E_t \left(P_{t+1} + D_{t+1} \right) / (1+R)$$

In rational bubble models the expected capital gains growth is slower then R and the transversality condition is violated:

$$\lim_{T \to \infty} \left(\frac{1}{1+R} \right)^T E_T P_{T+1}^F \neq 0$$

This non null entity is the bubble component B_t. The equity price is defined as:

$$P_t = P_t^F + B_t$$

$$P_t^F = \sum_{j=1}^{+\infty} \left(\frac{1}{1+R} \right)^j E_t D_{t+j}$$

where P_t^F is the fundamental price. Using market efficiency condition and rational expectations, it appears that B_t has to follow a discounted martingale:

$$E_t B_{t+1} = (1+R) B_t$$

This condition allows multiple settings for B_t. In the literature, most of the rational bubbles settings are driven by an exogenous factor. However endogenous rational bubble can exist. Froot and Obstfeld (1991) provide and test an "intrinsic bubble" model where the bubble component is a deterministic non linear function of the dividends. The authors interpret this specification as a systematic overreaction of stock prices to dividend news. Although this specification uses intrinsic market information about dividends in the bubble factor specification, it does not explain the endogenous systematic overreaction. The leverage bubbles can be an alternative setting for a rational bubble where the overreaction is endogenously formed by the active leveraging behavior and the

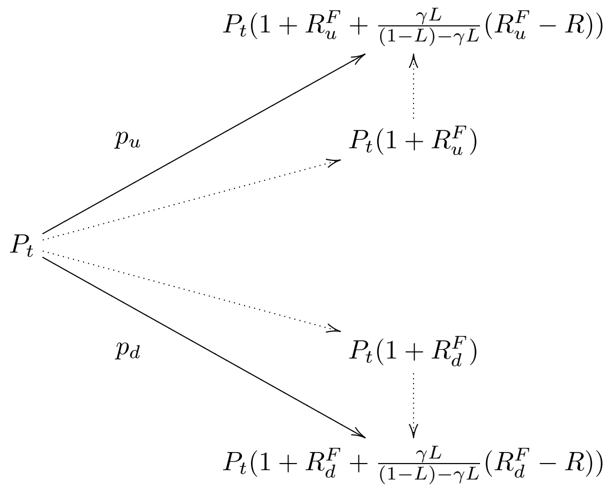

Fig. 5: Asset price overshoot

Mark to Market valuation of the balance sheet.

I assume a simple pricing kernel that has two distinct states in a risk neutral agents populated world. The world has a probability p_u of being in the 'up' state and $p_d = 1 - p_u$ to be in the 'down' state. In this setting the fundamental price return is R_u^F in the 'up' state and R_d^F in the 'down' state. And the risk free rate is constant and is equal to R.

If we assume γ constant for a matter of simplicity, the expected return rate is equal to:

$$E_t R_{t+1} = E_t R_{t+1}^F + \frac{\gamma L}{(1-L) - \gamma L}(E_t R_{t+1}^F - R)$$

Since in a risk neutral world the expected fundamental price return is the risk free rate $E_t R_{t+1}^F = R$ it follows that:

$$E_t R_{t+1} = R$$

Which shows that the leverage bubble is coherent with the definition of a rational expectation bubble. It follows a martingale[16] and thus does not affect the first moment of the price. The leverage bubble $LB_t = P_t - P_t^F$ is derived from equation 4.1 :

$$LB_t = \frac{\gamma L}{(1-L) - \gamma L}\left(R_t^F - R\right) P_{t-1} \tag{4.1}$$

[16] One can show that $E_t LB_{t+1} = (1+R)\, LB_t$

It is not obvious how a deterministic endogenous bubble can take place in a rational expectation agents market. It is puzzling to say that prices overshoot the fundamental level by a deterministic component when all agents are aware of such phenomenon. This is maybe a common problem with all endogenous rational bubble model. In exogenous bubbles models, like Blanchard and Watson (1983) model, the bubble is there because of an exogenous, usually undefined, trigger. Froot and Obstfeld (1991) had a similar comment in the introduction of their dividend overreaction rational bubble:

"It is difficult to believe that the market is literally stuck for all time on a path along which price dividend ratios eventually explode. If the market began on such a path, surely investors would at some point attempt the kind of infinite horizon arbitrage that rules bubbles out in theoretical models. [...] Perhaps agents do not really have as clear a picture of the distant future as the simplest rational-expectations models suggest"

There is maybe a way to explain how rational expectation and deterministic endogenous bubble can coo-exist in the Leverage Bubble model. As a matter of fact γ_t, the elasticity of asset prices, is function of agents reaction to changes in trades sizes. Having a non deterministic γ_t makes it hard to infer the fundamental price from the market prices. So even when agents are rational, arbitrage is made hard to achieve.

Another common problem raised by Blanchard and Watson (1983) is the fact that negative bubbles cannot exist. Although, the probability that the stock price becomes zero is small and can be ignored like commonly done in the periodically collapsing bubbles literature. Moreover as Weil (1990) notice if we assume that fundamentals, here the fundamental asset return, depends on the presence of bubble the negativity of bubble term is no more a theoretical constraint.

5 Policy recommendation

This chapter highlights the paper's conclusions and recommendations for policy markers:

1. *Active leveraging may lead to asset prices overshoot*

   It seems now natural to say that active leveraging may have asset pricing implication. However this statement is not as natural and intuitive as it seems. In the financial press and other market commentary, one is used to hear critics about excessive leverage building and procyclical leveraging. From the empirical revelation of Adrian and Shin (2008) paper, the procyclical nature of leverage behavior has retained the attention of commenters and policy maker[17]. However it is maybe more important to say that active leveraging, *even when countercyclical*, may lead to price overshoot. For instance, maintaining a constant leverage has never been seen as a potential danger since regulators in some countries are imposing a leverage limit and thus are happy with banks maintaining a constant leverage. In this paper I show that a simple *constant leverage* targeting rule may lead to a rational bubble formation when market is not perfectly liquid.

2. *Leverage without MtM accounting does not lead to bubble formations.*

   It is hard to believe that regulators should constraint the active leveraging since it is the nature of banks activities. Instead they may be tempted by reviewing the MtM accounting principle. In current regulation, balance sheets are continuously marked to market and this is what causes market participant balance sheet adjustments and active leveraging behavior. Nevertheless there are no yet a serious alternative to the Mark to Market rule. And accountants will argue that leverage impact is not caused by MtM accounting. Rather, MtM accounting reveals it.

3. *Given current financial institutions leverage level, only a small illiquidity is needed to make the overshoot effect important and persistent*

   The price overshoot is highly sensitive to γ. For the condition $0 \leq \gamma \leq \frac{1-L}{L}$ to be satisfied in current levels of banks leverage, γ shouldn't exceed a level of about 4%. What means that banks should be able to double their assets without moving the price by more than 4%. In addition, the more γ is close to 4% the more the overshoot factor tends to infinity and a γ of only 2% would overshoot the excess return by 100%. This shows that the described phenomenon is not marginal and that when the market shows signs of illiquidity the presence such leverage bubble is very likely.

4. *The ideal remedy would be a contracyclical dynamic leverage ratio (DLR) limit*

   Mark to Market is a natural and "fair" valuation rule. And active leveraging, i.e. borrowing to invest, is the nature of financial institutions business. Since then, the most efficient way for regulators to avoid leverage bubbles formation is to impose an appropriated leverage ratio limit that would be function of asset prices growth. From equation 3.1:

$$\frac{\Delta L}{L} = -(R_{t+1} - R)$$

[17] Adrian and Shin (2008) found out that security dealers and brokers have a Leverage level growth positively related to the asset growth.

Leverage ratio limit should grow by the exact amount of price excess return over borrowing rate but in the opposite direction. When banks target this contracyclical maximum allowed leverage level, there is no incentive for leverage motivated trading. This is because changes in prices do not lead anymore to a gap between the targeted leverage and the observed one. In addition, the leverage ratio limit also plays its traditional role of prohibiting excessive leverage building.

A bandwidth within which the leverage limit is allowed to move should also be defined. It is important to set a lower limit not to constraint banks too much in booming periods allowing them to remain profitable. And more importantly the upper limit of the band would prohibit a too high level of leverage, equivalent to a high level of risk, that would result from prices depreciation. This upper limit should be set to current regulation levels[18].

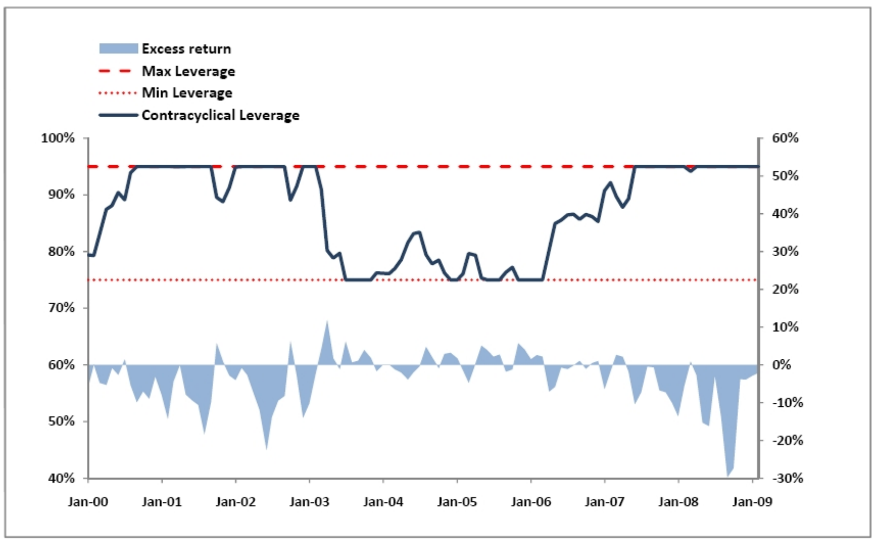

Fig. 6: The contracyclical dynamic of the DLR

To illustrate this I set a practical DLR rule that would have been in place and look at how the DLR would react to recent decade evolutions in UK market (figure 6). This figure is purely illustrative of how the DLR react to excess return, it does not say anything about what would have been the DLR in recent period. As a matter of fact, if a DLR rule was in place, part of the excess return that have been recorded would have been avoided.

[18] In the illustrative example I use the current leverage ratio limit in Canada

The DLR band is assumed to be [75%-95%]. The FTSE index return is assumed to be the benchmark for asset growth and the Euribor the benchmark for the borrowing rate. I use quarterly growth rate and a quarterly update of the DLR. The simulation starts with a leverage limit of 75% in December 1999. This is because after a booming period the leverage limit is likely to reached the lower band limit of 75%.

The figure shows a contracyclical shape of leverage: During the booming years of 2003-2007 the DLR varies around the lower limit when in during depressed market periods of 2000-2003 and 2007-2009 the leverage limit grows up to reach the higher limit of 95%. What is important to retain is that *the DLR allows no leverage overshoot whiting the DLR band.* Whereas, when the DLR reaches one of the band's limit, the rule that protect form price overshoot is no more active.

6 Conclusion

This paper provides a model for asset price overshoot generated by banks balance sheet adjustments. This asset price overshoot follows a discounted martingale and is coherent with a rational bubbles framework. A single bubble model cannot certainly explain the entire asset prices boom and crash phenomenon. Other potential balance sheet driven causes of price distortion can be regulatory arbitrages, maturity mismatch, or the use of short history in risk management practices. Moreover, in boom and crash situations there are interactions due to banks inter-linkage and to macroeconomics feedbacks that would impact banks behavior and prices. Nevertheless the aim of this framework is to shed the light on an important bubbles driver that is active leveraging, and to provide with a regulation rule to protect the financial system from leverage bubbles.

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